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ACCURACY OF FETAL WEIGHT ESTIMATION ON ULTRASOUND: A COMPARISON BETWEEN SHEPARD AND HADLOCK METHOD

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Abstract

Objectives: *To compare the accuracy of fetal weight estimation between the Shepard and Hadlock methods.*

Material and Methods: *This study was conducted after obtaining approval from the College of Physicians and Surgeons Pakistan and the Department of Radiology, National Hospital and Medical Centre Lahore. A total of 118 patients were enrolled, all of whom underwent ultrasound examinations. During the procedures, both the Shepard and Hadlock methods were used for fetal weight estimation, ensuring standardized equipment and protocols to reduce variability. The formulas used were the Hadlock II formula (Log10 EFW=1.335-0.0034 ×AC ×FL+0.0316 BPD +0.0457 AC +0.1623 ×FL) and Shepard's formula (Log10 EFW = – 1.7492 + 0.166 BPD + 0.046 AC – 2.646 (AC × BPD)/1,000). The actual fetal weight was obtained post-delivery by direct measurement of the neonate. Ultrasound estimation of fetal weight at term was used to collect data, which was then matched with the actual birth weight of the baby for comparison and statistical analysis was performed using SPSS Version 26.*

Results: *In this study, 118 pregnant women were enrolled. Of the newborns, 68 (57.6%) were male and 50 (42.4%) were female. Regarding gestational age, 70 infants (59.3%) were born between 30 and 35 weeks, while 48 (40.7%) were born between 36 and 40 weeks. The mean estimated fetal weight using Hadlock's formula was 3.3024 kg, compared to 3.2024 kg with Shepard's formula. The mean weight measured post birth via standard weighing scale was 3.1220 kg.*

Conclusion: *It was concluded that both Hadlock's and Shepard's formulas are useful for fetal weight estimation, but Hadlock's formula was more accurate, aligning closely with actual birth weight. This suggests Hadlock's formula may be the preferred choice for more precise fetal weight predictions in clinical settings.*

INTRODUCTION

Accurate estimation of fetal weight (EFW) is a critical aspect of prenatal care, playing a pivotal role in guiding clinical decisions related to labor, delivery, and neonatal management.(1,2) An accurate

prediction of fetal weight can help in the early identification of growth abnormalities, such as intrauterine growth restriction(IUGR) or macrosomia, both of which are associated with significant perinatal complications.(3,4)

Obstetric ultrasound has become an indispensable tool in this regard, allowing clinicians to noninvasively estimate fetal weight using specific biometric parameters. Among the various methods developed for EFW, the Shepard and Hadlock formulas are two of the most widely employed techniques.(5,6) Low birth weight refers to a condition where a newborn weighs less than 5 pounds, whereas the average weight of a baby is approximately 8 pounds.(7) Several factors can contribute to a decrease in fetal weight, including conditions such as intrauterine growth restriction (IUGR), which hampers the baby's growth within the womb, and oligohydramnios, characterized by insufficient amniotic fluid.(8) These conditions can significantly affect the development and overall health of the fetus. Conversely, there are also circumstances that can lead to an increase in fetal weight at birth, such as maternal diabetes or excessive gestational weight gain, which can result in macrosomia (a larger-than-average baby).(9)

Accurate assessment of fetal weight during pregnancy is essential for identifying and managing these complications. By detecting deviations in fetal weight early, healthcare providers can intervene appropriately, reducing the risks associated with both low and high birth weights. Regular monitoring and ultrasound evaluations provide crucial information that aids in tailoring treatment strategies to optimize maternal and fetal outcomes.

Objectives: To compare the accuracy of fetal weight estimation between the Shepard and Hadlock methods.

MATERIAL AND METHODS:

Study Design: Cross sectional study

Study setting: This study was conducted at the Department of Radiology, National Hospital & Medical Centre Lahore.

Duration of the study: The study duration was 3 months from 28th Oct 2024 to 28th Dec' 2024

Sampling technique: Non-probability consecutive sampling.

Inclusion Criteria:

- Pregnant women between 30 and 40 weeks of gestation.
- Patients with singleton pregnancies.
- Normal fetal anatomy on ultrasound, with no major structural abnormalities

Exclusion Criteria:

- Women with pregnancies involving fetal abnormalities.
- Women who have undergone fertility treatments that might significantly affect fetal growth or weight estimation.
- Use of medications during pregnancy that could affect fetal growth (e.g., corticosteroids, certain anticoagulants).
- Women with uterine abnormalities.
- Pregnant women with any placental abnormalities.
- Pregnant women with significant medical conditions, including gestational diabetes mellitus or pre-existing diabetes, hypertensive disorders (such as chronic hypertension and preeclampsia), and serious renal, cardiac, or respiratory diseases.

Methods:

This study was carried out following approval from the College of Physicians and Surgeons Pakistan. And the department of Radiology, National Hospital & Medical centre Lahore. Total of 118 patients were enrolled. All patients meeting the inclusion criteria underwent ultrasonography (USG) as part of the diagnostic evaluation and data collection. The ultrasound examinations were performed using both the Shepard and Hadlock methods for fetal weight estimation, ensuring that standardized equipment and protocols were utilized to minimize variability. Two formulae were used for the estimation of exact fetal birth weight which was hadlock's formula, shepard's formula. The formula were: Hadlock II (10) formula (Log10 EFW= 1.335- 0.0034x AC x FL + 0.0316BPD+0.0457AC+0.1623xFL) and Shepard formula (11) (Log10EFW=–1.7492+ 0.166BPD+0.046AC–2.646(AC×BPD)/1000).

Actual fetal weight was obtained post-delivery through direct measurement of the neonate. A pre-design

questioner was used to collect data. For statistical analysis we used SPSS Version 26.

RESULTS:

In this study, a total of 118 pregnant women were enrolled. The analysis of baby gender distribution indicated that 68 infants were male, making up 57.6% of the total, while 50 were female, representing 42.4%. In terms of gestational age, 70 babies were born between 30 and 35 weeks, accounting for 59.3%, whereas 48 babies were born between 36 and 40 weeks, comprising 40.7%. The mean estimated fetal weight using Hadlock's formula was 3.3024 kg, with a standard deviation of 0.5183 and a standard error of 0.0477. In contrast, Shepard's formula yielded a mean of 3.2024kg, with a standard deviation of 0.4666 and a standard error of 0.0429. The mean actual birth weight was 3.1220kg, with a standard deviation of 0.4251 and a standard error of 0.0391.

Table 1: Frequency of Gender of babies and Gestational age (n=118)

Gender of babies	Frequency	Percentage
Male	68	57.6%
Female	50	42.4%
Gestational Age		
30-35 weeks	70	59.3%
36-40 weeks	48	40.7%

Table 2: Comparision of the accuracy of different sonographic formulae with actual weight for the detection of fetal weight (n=118)

	Mean	SD	Standard Error
Hadlock's Formula	3.3024	0.5183	0.0477
Shepard's Formula	3.2024	0.4666	0.0429
Actual Birth Weight	3.1220	0.4251	0.0391

Discussion:

The accurate estimation of fetal weight is crucial for prenatal care, as it significantly influences clinical decision-making regarding the management of pregnancy and delivery. This study aimed to compare the accuracy of two commonly used sonographic formulas: Hadlock's formula and Shepard's formula, in estimating fetal weight against actual birth weights. Two equations were utilized in this study for ultrasound fetal weight estimation: Hadlock's formula and Shepard's formula. The findings of the present study indicated that Hadlock's formula emerged as the most accurate method for estimating birth weight. Hadlock's formula is commonly used in Pakistan for estimating fetal birth weight. Our findings indicate that Hadlock's formula provided a higher mean estimated fetal weight (3.3024kg) compared to Shepard's formula (3.2024kg). This discrepancy suggests that Hadlock's formula may have a tendency to over estimate fetal weight, which aligns with previous research indicating that variations in measurement techniques can lead to differences in estimated weights. When comparing these estimates to the actual birth weight, which averaged 3.1220kg, it is evident that both formulas may not perfectly align with true fetal weights. The proximity of Shepard's formula to the actual birth weight suggests that it may be slightly more reliable in certain populations. However, the clinical relevance of these differences necessitates further exploration, as even minor inaccuracies can have significant implications for clinical practice, particularly in identifying cases of fetal macrosomia or intrauterine growth restriction. A study conducted by Nir Melamed et al.(12) supported our study finding. The choice of a specific equation for fetal weight estimation ultimately rests with the user, as there is no universally accepted formula deemed the most applicable or accurate. Relying on a single equation may lead to inaccuracies and misinterpretations of fetal growth and health status.(1) The present study demonstrated that Hadlock's formula is one of the most effective

methods for estimating actual birth weight. The analysis revealed that the mean birth weight calculated using Hadlock's formula closely aligns with the actual mean weight observed in the study population. This close correspondence indicates that Hadlock's formula may provide a more reliable estimate compared to other methods.

Accurate fetal weight estimation is crucial for clinical decision-making, particularly in determining appropriate management strategies during pregnancy and labor. Given that the mean estimates derived from Hadlock's formula were consistent with the actual weights, this method may help clinicians make informed choices regarding the timing and mode of delivery, ultimately improving maternal and neonatal outcomes. These findings underscore the importance of using validated estimation formulas in clinical practice, as they can significantly enhance the accuracy of fetal weight assessments and reduce the likelihood of complications associated with misestimation.

The ability to accurately estimate fetal weight is paramount in guiding interventions such as the mode of delivery and the timing of birth.(13) Overestimation can lead to unnecessary cesarean sections, while underestimation may result in adverse neonatal outcomes.(14) Therefore, clinicians must be aware of the potential limitations of these sonographic formulas and should consider integrating additional factors, such as maternal health, gestational age, and previous obstetric history, when making clinical decisions.

Conclusion:

In conclusion, this study demonstrated that both Hadlock's and Shepard's formulas are valuable tools for estimating fetal weight via ultrasound, but Hadlock's formula proved to be more accurate. The mean fetal weight calculated using Hadlock's formula closely aligned with the actual birth weight compared to Shepard's formula, which exhibited slightly greater variance. These findings suggest that Hadlock's formula may be a more reliable method for predicting fetal weight, particularly in clinical settings where precision is critical for managing pregnancy outcomes. The study highlights the importance of using standardized methods and protocols to enhance the accuracy of fetal weight estimations.

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